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ABSTRACT

The authors describe the functions of an integrated systems approach in solving the administrative, academic, and logistical problems of a large university department. They discuss the roles of a computer managed instruction system for the University of Florida's College of Journalism and Communication. First, the system can record student and faculty profiles, so that instruction can reflect individual student requirements. The computer managed system can also be of value in the shaping of educational objectives by identifying, grouping, and building modules of instruction and establishing the objectives for each module at various levels of recognition. Finally, once the student profiles and the instructional objectives have both been established, the appropriate "instructional mix" for each student can be determined. The authors also discuss the purpose of computer assisted instruction within the computer managed system, the role of the system in the college's relationship with media professionals, and possibilities for research utilizing the computer managed instruction system. (RN)

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COMPUTER MANAGED INSTRUCTION:

TOWARD INDIVIDUALIZED LEARNING

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Introduction

Our College of Journalism and Communications at the University of Florida is one of the largest and fastest growing in the nation. In the decade from 1960 to 1970, the number of undergraduate majors grew from 126 to 825--an increase of 555 percent. Our college led the nation last year in the number of undergraduate degrees awarded, 392, and if only juniors, seniors and graduate students are counted, we led the nation in the total number of journalism majors, 922.[1]

We find that associated with this rapid growth and large student body are problems of corresponding magnitude:

> Administrative--The record keeping for nearly 1,000 students requires a number of full-time staff members. Administrators, staff and faculty spend a great deal of their time anticipating students needs and interests, determining course content, assigning instructors to teach courses, scheduling students into limited classroom facilities and keeping records of their progress through the sequence of instruction.
>
> As student-to-faculty ratios continue to grow, the budgeting of faculty time for teaching, developing course materials, counseling and research becomes more complex.

> Academic--More and more the emphasis in education is on recognizing individual differences among students and individualizing instruction to meet these needs. Prof. Harvey Saalberg related one aspect of individual differences to J-school students:
>
> "A March 1970 survey taken by Kent State University's School of Journalism . . . shows that the percentage of students without journalism background pursuing an MA or MS in journalism at . . . 43 (graduate journalism schools) ranges from 0 to 90 percent. The average percentage was 42. The spread is tremendous . . ."[2]

With close to 1000 students, even if individual differences are ascertained, the logistics of sorting out students' requirements and planning the best instructional mix to meet the needs of each would place an even heavier burden on an already overburdened staff. For example, if in a beginning writing class of 25 students where 10 objectives are to be taught in each of four major-content areas, there is a possibility of 1000 student and learning unit combinations.

A neglected area of individual differences, and one which would further complicate the problem, is determining instructor profiles based upon competencies, interests and motivations and attempting "best-fit" matches among teachers and students. We accept the premise that a sizable proportion of our students are self-actualizing and achievement motivated. We expect that such students will function best when they are matched with instructors of like motivation.[3]

Logistical--Assigning classrooms, scheduling equipment and media (projectors, recorders, tapes, etc.) and procuring and maintaining supplies consumes a great deal of staff and faculty time. If, as we have said, there is a trend towards individualizing instruction and more reliance is placed upon using a variety of media and instructional materials, the logistical problem is bound to increase.

Paradoxically, there are times (early mornings, evenings, weekends) when classrooms are empty and equipment is not being used, while at other times (Monday through Friday during late mornings and early afternoons) instructors often find themselves in competition for these facilities and resources.

In this paper we discuss how an integrated systems approach can be used to help solve these problems.

The Role of CMI in the System

Computer-managed instruction (CMI) is a management tool not unlike computer-based systems used in industry. Data bases are provided to the system, usually in the form of student records and teaching input such as testing materials and learning objectives.

CMI is more than just a management tool, however, It implies a teaching philosophy that emphasizes recognizing individual differences and providing individualized instruction. It implies also

motivation, feedback, recognition and rewards to capitalize on the self-actualizing needs of our students.[4]

In a fully implemented CMI situation, the details of administration, testing, allocation of resources and even, to a great extent, guidance and counseling are taken over by the system, thereby allowing faculty and staff more time to concentrate on individual problem solving and the more abstract areas of instruction.[5]

One such fully-implemented system is being developed now by the newly-formed College of Dentistry at the University of Florida. Instruction is divided into small units or modules, each of which contains entry and exit behavior testing. The computer directs students to a variety of teaching resources, including audio and video tapes, slides, programmed texts and computer-assisted instruction, based upon individual performance and needs at each level of instruction. Progress through the sequence is for the most part (some time restrictions are set) dependent upon the student's rate of learning.

The system uses an IBM 360/65 computer accessed either by time-sharing through an IBM 2741 communications terminal or by batch-mode processing. Courses are written in IBM's Coursewriter III, which is an easy-to-learn author language used to prepare computer assisted instruction (CAI). Data are automatically collected on each student each time he or she types in a response to a computer-generated question or problem. These data are then used as feedback to appropriate "module development teams" to refine and improve the system.

Figure 1 shows an overall block diagram of a CMI system as we envision it for the College of Journalism and Communications, although

NOTE

The authors regret they misinterpreted the stage of CMI development at the UF College of Dentistry described below.

The management model described is correct in concept, but to date only a single module, a CAI unit called MEDEMRG - has been developed. Further development is awaiting decisions relating to computer support.

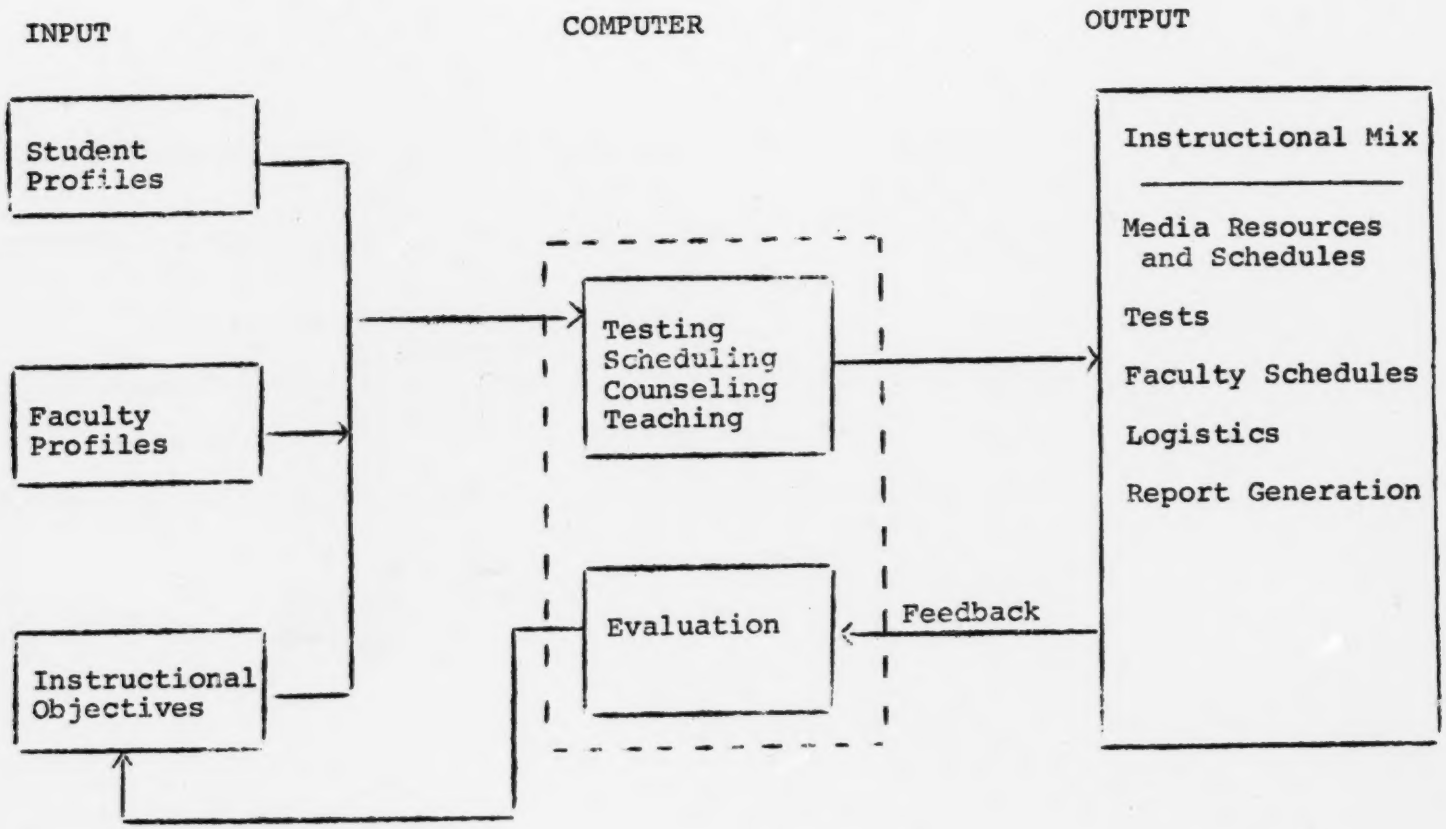

FIGURE 1

Block Diagram of a CMI System

as shown, it is not discourse specific and might be applied to any learning situation where individualized instruction is the goal.

Certain of the components of the diagram are examined in this section to show the role of the computer in initializing, evaluating and improving the system.

A. Student and Faculty Profiles

Instruction should reflect individual student requirements. Provisions are included in the proposed system to anticipate these needs.

It should be possible, for example, for a student to by-pass certain modules of instruction if he is qualified to do so. The CMI approach makes such branching possible by administering tests based upon expected terminal behavior. Thus, if entry behavior for a particular module equals or exceeds the terminal requirements, the student should be able to by-pass that module and proceed to more challenging work.

Conversely, prerequisite testing would show whether or not a student is prepared to enter a particular module of instruction.

Figure 2 shows a branching and looping system used by Suppes in his CAI for mathematics.[6] The seven objectives shown are related to a given module of instruction, and each must be met with a given level of competency before passing on to the next. Levels A,B,C and D indicate depths of instruction for each objective. Thus, students can by-pass instruction entirely (Level A), be given increasingly deeper instruction (Levels B, C and D) or (as is usually the case) be given a mixture of these as they proceed through

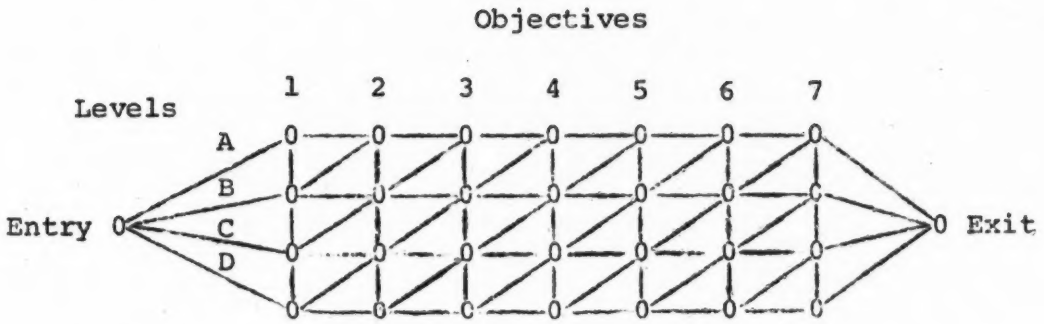

FIGURE 2

CAI Branching and Looping System

the module. Suppes' model is not presented here as the optimal one for instruction, but it is an example of the kind of planning necessary to individualize and optimize instruction.

The dynamic characteristics of instructional needs as shown above occur at a micro level of learning. At a macro level are needs such as self-actualization and other psychological characteristics, desires, intellectual and vocational interests, technical skills, capabilities and limitations.

These needs, skills and interests can be stored as a permanent part of students' records in the system (in computer memory) and provide at every level of instruction the raw data for a "best-fit" instructional mix.

Faculty profiles can also be given to the system so that, for example, a student who is not a "self-actualizer" and who may not function well if left mainly to self motivation can be given a great deal of interaction with a mentor or instructor whose interests and even personality type best match his or her own. Options can, of course, be provided when personality clashes occur or when the theoretical "best-fit" fails to provide the desired learning behaviors.

Record keeping such as we have suggested here and the large number of possible student/learning combinations are nearly an unmanageable task for humans--such tasks are trivial for a third-generation computer.

B. Instructional Objectives

We make a distinction here between educational goals and instructional objectives. Educational goals are dynamic entities which reflect changing institutions and changing student and faculty requirements. We prepare our students to work and live in environments both as we presently see them and as we envision them to become. If our educational goals do not reflect changing institutions and environments we do our students an injustice.

For example, a news/editorial student leaving college in the 1970's without at least a minimal understanding of the capabilities and limitations of computers is not fully prepared to work at a newspaper which uses CRT editing, acoustic-coupled reporting devices, information storage and retrieval systems, tapes of census or government data, etc.

Instructional objectives in turn reflect educational goals. Each major content area of instruction is dissected to identify those parts which taken together constitute the goal. By dissecting, identifying, grouping, and regrouping, modules of instruction are formed. Modules are further broken into instructional units and instructional objectives are established at various levels of cognition.[7] For example:

> JM 301 (Elementary Reporting) students, after studying an audio tape-looseleaf notebook instructional unit on journalism terms, will score at least 90 percent correct on a multiple-choice test on these terms. The test will be given at the end of the week in which the material is to be covered. (knowledge level)

> JM 340 (Editing) students, given a news budget and a list of hypothetical stories and photos, will demonstrate skill in makeup by selecting page 1 material and marking it on a dummy page. Acceptability will be determined by comparing student performance against the combined judgement of teachers of the course. Students must demonstrate an awareness of (1) immediacy, (2) timeliness, (3) impact . . . . (application level)
>
> COM 601 (Introduction to Mass Communication Research Methods) students, after lectures and exercises on six techniques of attitude scaling (the six would be listed here), will evaluate any one of the six by detecting the presence or absence of the set of criteria (discussed in class) for good scales. This evaluation will be an essay on the strong and weak points of a particular technique, and the criteria for evaluation must be correctly identified. (evaluation level)[8]

Computer-managed instruction would allow us to anticipate changing educational goals and the corresponding new instructional objectives. Entry and terminal behavioral tests for most modules of a system can be stored in the computer and updated as the need arises. Machine-readable data cards and computer-assisted instruction can be used to combine record keeping and test administration.

For behaviors not readily adaptable to machine presentation and evaluation, levels of performance and evaluation criteria may be kept in computer storage as a part of students' records and retrieved as they are needed.

When instructional objectives are carefully laid out (as they should be no matter what kind of instructional system is being used), there is nearly a one-to-one mapping of these objectives into the CMI model. The student either masters the objective and is allowed to move to the next area of instruction, or does not master the objective and is given remedial work and retested.

Clearly, preparing instructional objectives is not a trivial task; indeed it is one of the most time-consuming and important

parts of the CMI system. Stolurow has pointed out that objectives must meet these minimum substantive criteria:[9]

1. Every unit of behavior must be described.
2. The conditions under which the behavior is to occur must be specified.
3. The minimum level of acceptable performance must be specified.

In addition to these, certain psychological criteria are often stated, such as, rate of learning, amount of retention and degree of transfer to other areas of learning.

Ease of refining objectives and their associated criteria in light of student experience and feedback is a major advantage of CMI over traditional instructional systems. This is due to the enormous amounts of data that can be collected and analyzed, and to a characteristic of the CMI concept: dynamic alteration of modules and objectives as educational goals evolve.

C. Instructional Mix

As we have indicated, the appropriate instructional mix for a given student under given conditions depends a great deal upon student profiles and the instructional objectives. Once these matches are obtained, we have a variety of media from which to choose, and the results of numerous studies provide indications of what kinds of media are most appropriate for various kinds of learning.[10]

Examples of the resources available to us include audio and video tapes, ITV, films, slides, programmed texts, computer-assisted instruction, conventional texts and traditional instruction (lectures, labs, etc.).[11] Of those listed, conventional texts and traditional

instruction are the two most widely used in present-day instructional settings. They may, however, be the least effective methods of teaching. Roberts[12] has analyzed relationships among media and learning objectives. He rates conventional texts and oral presentations as medium to low for these objectives: learning factual information, learning visual and audio identification, learning principles, concepts and rules, learning procedures, performing skilled perceptual-motor acts, and developing desirable attitudes, opinions and motivations.

In addition to the media listed above, group discussions, one-to-one teacher/student dialogs, field trips, individual research and other non-media methods can be effectively applied to certain learning situations.

The point is that CMI compels us to closely examine the learning activity we wish to take place and to choose the media and teaching methods best suited to that activity.

We have indicated in Figure 1 that the instructional mix includes facilities other than media and non-media teaching resources. Such facilities are the administrative ones which are aided or performed by the computer and include effective manpower utilization, time and space allocation, record keeping, counseling, report generation, immediate and over-time program evaluation and program generation.

One of the obvious problems in self-paced instruction is the record-keeping that is necessary to determine whether the student has met specific requirements for graduation. One might consider an extension of a computerized self-counseling system used at

the University of Texas.[13] A student's transcript serves as a data base and a report is generated for the counselors and the student showing the number of major and minor credits needed for graduation and the requisite and recommended courses that will fulfill those requirements. A similar system is being utilized in the College of Arts and Sciences at the University of Florida. These systems could be adapted to either direct or monitor the progress of the student as he goes through CMI sequences.

The full calculating powers of the computer can be used in a CMI system to prepare and generate reports. Correlation or other statistical processes are easily implemented in a CMI system since constantly-upgraded student records constitute a part of the data base, and cases can be selected for analysis based upon a wide variety of specifiable characteristics.

CMI also allows subsystems to be incorporated into the instructional mix as they become available. For example, the University of Florida's Computing Center is in the process of implementing the Basic Information Retrieval System (BIRS) that was developed at Michigan State University. This system, when incorporated into CMI will give students, administrators and researchers access to a powerful information storage and retrieval system.

CAI as a Component of CMI

Computer-assisted instruction (CAI) can be a component of CMI and a distinction is made between the two. CMI, as we have described above, is the overall management system used to achieve individualized

instruction. CAI, on the other hand, implies a student/computer dialog relating to a specific discourse or area of instruction.[14]

We might, for example, use CAI to teach students the basic elements of a news story or common copyediting symbols.

CAI is normally used in much the same way as the familiar programmed instruction (PI) books, in that instruction is given in small bites, feedback is immediate and branching and looping techniques can be used to skip material or provide remedial work. Two major advantages of CAI over PI are a greater flexibility for branching and looping and the ease with which changes in the material can be made. Also, response data are automatically collected as the students use CAI, and analysis of these data facilitate course revision.

CAI for journalistic writing must, we feel, be viewed differently from the traditional linear/branching methods. Critiquing a news story and providing immediate feedback to the writer means that a large amount of text must be analyzed rather than a one or two word response as in conventional CAI.

Bishop[15] is using a set of syntactical analysis programs to critique certain stories for which he has already stored in computer memory certain key words and phrases. Another of Bishop's programs (and one which is discourse independent), checks students' stories for certain stylistic errors such as overuse of passive verbs or adverbial clauses, lengthy sentences and paragraphs and common spelling and abbreviation errors.

We are attempting to implement CAI at both the syntactic and semantic levels; the assumption is made that development and cohesion

are two very important characteristics at the sentence, paragraph and entire-text level. Experiments are underway to help us define what is meant by development and cohesion and what their indicators are in journalistic writing.

Specifically, we have created a 1000 word concordance and a rapid dictionary search algorithm for the most commonly used words in the English language.[16] This concordance and search algorithm are now being used to detect word-occurance similarities between an instructor's and his students' stories (all of which were written about the same set of facts) and whether or not this similarity plays a part in the instructor's grading.

In later research, semantic analysis of students' stories will be a "beyond-the-sentence" analysis--initially at the paragraph level and later at the entire-text level. We hope to discover and formalize those journalistic "rules" of writing that are used by students in their writing and to critique their use of those rules. Intuitively, we expect such rules to include transition, development (going somewhere), cohesion (unity) and certain logical relationships (such as temporal, spatial and causal).

CMI in College Relationships with Professionals

Newspaper executives were asked in a recent nationwide study, undertaken by a University of Florida graduate student,[17] whether journalism education had given its graduates adequate instruction about how new technology such as computers might be utilized in the

media. Nearly 63 percent of the respondents said it had not. Only about five percent said it had.

The pressing problem in the media, as expressed to one recent job-hunting student, is that "We need people who can tell us how or where we can use computers." The emphasis seems to be on the need for innovation--not just the recognition of the obvious computer applications, such as in payroll processing or machine management. A probable fringe benefit of CMI is that students, themselves, are likely to project applications of the systems that are being used in instruction.

Another aspect is that educators may develop CMI applications in extension education services.

Take the example of the newspaper that must fill an editing slot by retraining a reporter for the job. The traditional approach would be to make him a sort of apprentice, letting him learn gradually by observing, working at a low level of efficiency, and asking questions or using trial and error. His efficiency may be low for a period of a week to several months, and because he has to be helped along, the efficiency of his co-workers also may be impaired. CMI, however, could make it possible for the reporter to engage in intensive self-controlled editing instruction that could make him operationally competent much more rapidly.

Where would the CMI sequence originate? It could be a modified version of a CMI sequence in editing that is utilized in a college classroom. The CAI units that are stored in a university computer could be accessed through a terminal in the newspaper--for example,

a terminal that might be used during other hours to input newspaper stories or to edit copy. The availability of CMI would make possible the in-house training that usually is not attempted because of the lack of a person designated as a training officer. CMI would help provide the management that is needed to undertake such in-house training.

The general idea of extending CMI and CAI to professional organizations has been broached to some Florida newspaper executives. The response has been generally favorable, with "When?" being the main question. Some discussion of applications has focused on special language skills training for members of minority groups or persons who show promise as reporters but have language skills deficiencies. Other discussion has focused on the development of instructional units dealing with specialized reporting tasks--e.g., reading and interpreting financial reports, government documents, or other relatively technical materials. At a very pragmatic level, a CMI sequence might be developed for students, newspaper personnel and executives about the functions and editorial operation of computers in newspapers.

It is expected that the needs of the mass media will result in major leaps in production technology--such as that exemplified in Media General's Financial Daily in Richmond, Va. However, it is likely that journalism educators' interests in the analysis by computers of writing and the development of other CAI programs will not duplicate those other efforts, but could make valuable new contributions.

Research Possibilities Using CMI

A wide variety of research possibilities are suggested by the CMI format described above. Some of the most relevant here relate to the communication process. A few notions along these lines will be briefly indicated, and then some other types of research applications will be suggested.

One line of possible work is a systems approach to the communications processes as related to student learning. Among the questions that might be usefully studied using the data gathering and evaluation potentialities of CMI are the following: What are the optimal mixes of information media for different learning situations? When do information overloads start to impede communication? Within the framework of allowance for individual differences in rates of progress through instructional material, are there optimal levels of psychological pressure on the student so far as his learning is concerned? How would these optima vary by psychological characteristics of the students? What effects would varying administrative structures have on communication feedback processes within the CMI system? Is it possible to apply fruitfully principles of statistical linguistics to machine evaluation of student production?

The match of student and teacher profiles as a basis for assignment of "mentors" raises a number of interesting questions, both theoretical and methodological. What types of psychological, professional, and other information should be considered? How should the matches be made? What are the effects of developing different forms of relationships between the students and the faculty, for

example, mentor, advisor, or colleague?

Characteristics of teaching messages offer another field for research. Would one-sided or many-sided arguments be preferable? Should materials use humor, and if so, how? Should there be an attempt to make the student-computer relationship appear to be a personal one, as if the student were communicating with an instructor on a terminal in another room?

Since it will be possible to store, in easily retrievable form, an unprecedentedly wide variety of entry and progress evaluation data on each student, the area of testing is open to new approaches. How should students be evaluated? How can success on the job after graduation be used as an input for feedback to instructional and evaluation strategies and materials? Is it possible to develop "early warning" indicators relating to post-graduation professional performance? What is the relative importance of psychological and work-habit factors, as compared with ability to successfully negotiate traditional testing and evaluation procedures?

It is visualized that cathode-ray tube (CRT) terminals will be an important mode of student-computer interaction, among others. This opens the possibility of programs of research in application of these devices to professional situations: news writing and editing, library searches, gathering of data from governmental agencies, and other activities.

CMI, as viewed here, will also require considerable research in computer software and hardware. While the results may not be as important for communication teaching, theory, and professional

activities as the research activities suggested above, the possibilities for computer science and administrative applications are exciting. Among the approaches that would have interest are, for example, optimizing strategies for on-line interactive systems that require sophisticated information storage and retrieval functions.

These are only a few of the many possibilities, presented in only the most cursory manner. It is important to realize, however, that the CMI approach brings with it such opportunities.

Footnotes

1. These latter figures are presented and may be compared with other journalism schools in Journalism Educator, 26, January, 1972, pp. 4,5,56-60. The journalism school at the University of Texas leads in total enrollment (1,128) when freshman and sophomores declaring a journalism major are added.

2. Harvey Saalberg, "Graduate Students Welcome Opportunities to Learn J-Fundamentals They Lack," Journalism Educator, 25, Summer, 1970, p. 22.

3. This combination may or may not be a "best fit," but the point is still made that teacher/student profile matching can result in better interaction and better teaching than if this selection is left to chance.

4. Maslow (1954) identified self-actualization as the most important need satisfier. In descending order following self-actualization are esteem, belonging/love, safety and basic physiological needs. McClelland (1961) identified a triangular relationship among achievement (Maslow's self-actualization), power and affiliation. Lafferty (1970) added security/avoidance to form a quadrangle of needs.

5. Cooley has described resource allocation, data bases, curriculum scheduling, student monitoring and teacher roles in a CMI system.

6. The model shown here is actually an adaptation of Suppes' more complex model. His model is used for CAI at the elementary school level, but the approach can be used at any grade level as a technique for branching and looping.

7. See Mager (1962) for preparing instructional objectives and Bloom (1956) for levels of cognition.

8. These examples are adapted from a handout, "Writing Behavioral Objectives," prepared by Kurt Kent, Communication Research Center, College of Journalism and Communications, University of Florida.

9. Stolurow (1970), p. 1019.

10. A good overview of these studies and CMI in general is given by Brudner (1968). See also Rossi and Biddle (1967) for a discussion of the "new media and education."

11. Several programmed and computer-assisted instructional units have been developed or adapted for our teaching use at the College of Journalism. Information about these can be obtained by writing to Robert Simmons, Director, CRC, College of Journalism and Communications, University of Florida. We also publish a quarterly newsletter, CAPRICE (Computer-Assisted and Programmed Instruction in Communications Education), by which we keep readers informed of the latest developments in individualized instruction for journalism. To get on the mailing list, write Robert Moore, Editor, CAPRICE, College of Journalism and Communications, University of Florida.

12. Undated, untitled handout prepared by Dayton Y. Roberts, Institute of Higher Learning, University of Florida. The Bibliography section of this paper lists another work by Roberts dealing with humanizing learning through the systems approach.

13. From a conversation with Wayne Danielson, Dean, School of Communications, University of Texas, Austin.

14. A recent survey by Stolurow (1971) describes CAI languages, systems, response types, research, modes of instruction, behavioral objectives and instructional materials and testing.

15. Personal correspondence. See also bibliographic entries.

16. This concordance was created from a corpus of 1,014,232 words of natural-language text (Kucera & Francis, 1967). The words were taken from 500 samples representing 15 genres. Eighty-eight of the samples were taken from three press genres: reportage, editorial and reviews.

17. Susan Turner Bennett, "The Computer Revolution and the Modern Newspaper," an unpublished master's thesis. University of Florida.

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